

Massachusetts State Sustainability Fact Sheet #2

SUSTAINABLE DESIGN & CONSTRUCTION

HIGH PERFORMANCE BUILDINGS, PUBLIC HEALTH AND THE ENVIRONMENT

Dear Friends:

Sustainable design is a comprehensive approach to constructing and renovating buildings that are aesthetically pleasing and comfortable, while minimizing the impact on public health and the environment. Sustainable design can impact a range of environmental and health issues, from energy and water consumption, natural resource use, solid wastes generation and indoor air quality, among others.

This fact sheet provides the basics about sustainable design, and a context for delving deeper into the issue. It is one in a series produced by the State Sustainability Program, which promotes improved environmental practices at state agencies. The program was established by Executive Order #438 in July, 2002.

EOEA is committed to finding creative strategies to improve our environment and protect public health efficiently and cost-effectively. Sustainable design is one such approach and I look forward to joining with you in encouraging these efforts.

Sincerely,



Bob Durand
Secretary EOEA



PUBLIC LEADERSHIP,
STEWARDSHIP, COMMITMENT

www.mass.gov/envir/sustainable

Sustainable Design for High Performance Buildings IS About:

- improving public health and reducing environmental impacts
- maximizing energy efficiency and conserving natural resources
- integrating technology and common sense into building design
- incorporating sustainability issues throughout the design process
- involving key stakeholders in all phases of the process

Sustainable Design for High Performance Buildings IS NOT About:

- adding green elements to an existing process
- focusing only on design elements
- relying solely on technological solutions
- focusing on environmental issues at the expense of occupants, health and safety

What Sustainable Design Can Do For You

- Reduce capital costs
- Lower operating and maintenance costs
- Increase occupant productivity, lower absenteeism and improve employee job satisfaction
- Minimize exposure to toxic emissions

The Problem

In the United States, and worldwide, buildings are a major source of air pollution, and greenhouse gas emissions. Nationally, buildings account for 49% of sulfur dioxide emissions, 25% of nitrous oxide emissions, and 10% of particulate emissions, as well as 35% of carbon dioxide emissions, the chief pollutant blamed for climate change.

- The U.S. has more than 80 million buildings and will construct another 38 million buildings by 2010.
- Buildings use one-third of all the energy consumed in this country and two-thirds of all electricity generated.
- Building construction generates 136 million tons of waste per year in the U.S.
- Buildings account for one-quarter of the world's wood harvest.



The Commonwealth of Massachusetts
Jane M. Swift, Governor

Executive Office of Environmental Affairs
Bob Durand, Secretary

Sustainable Design – The Issues

When selecting the most appropriate design to minimize or reverse negative impact on health and the environment, evaluating and choosing appropriate technologies is important, but only part of the answer. Building design, siting, land use, materials, equipment, construction and operations and maintenance practices all contribute a building's sustainability.

Issue #1: Energy Conservation and Clean Energy

Mechanical systems should be sized correctly based on actual needs of the building and its occupants. Use high levels of insulation, high-performance windows and daylighting techniques. Flexibility in mechanical systems should be encouraged to accommodate changing uses as occupant needs change. Incorporation of renewable energy sources, such as solar hot water heaters, photovoltaics—and even fuel cells—can prove to be cost effective and may attract additional funding sources.

***Did you know...** that if only 10% of homes in the U.S. used solar water-heating systems, we would avoid 8.4 million metric tons of carbon emissions each year, equivalent to removing 1.4 million cars from the road?*

Issue #2: Healthy Indoor Environments

Creating a work or home environment that is attractive, comfortable and healthy is critical. To minimize energy use and reduce indoor air quality problems, include natural lighting, provide day-lighting, design natural and/or mechanical systems to provide effective ventilation, and consider localized climate control for building occupants. These strategies can increase employee productivity, reduce absences, and avoid sick building syndrome.

***Did you know...** that in a recent study, students in classrooms with the most natural light progressed 20% faster in math, 26% faster in reading and scored 25% higher on standardized tests than students exposed to the least natural daylight?*

Issue #3: Environmentally Preferable Materials and Waste Reduction

The choice of building materials can significantly affect indoor air quality, the durability of a building and natural resource extraction. Many construction materials -- such as insulation, steel framing, and sheathing for building exteriors -- are now made with recycled content, while some wood products may come from salvaged materials as well as from sustainably harvested stocks. Consider long-term durability and recyclability of materials. Avoid materials that contain toxic chemicals and those that emit volatile organic compounds (VOCs), which may include certain paints, adhesives, finishes, carpets, and particleboard. Before starting construction, consider reducing construction debris that must be sent to a landfill by providing on-site source separation and recycling. Incorporate a building's future recycling needs into the building's design.

***Did you know...** each year that the U.S. generates 136 million tons of building construction and demolition waste, only 20 to 30% of which is recycled or reused?*

Issue #4: Water Conservation and Quality

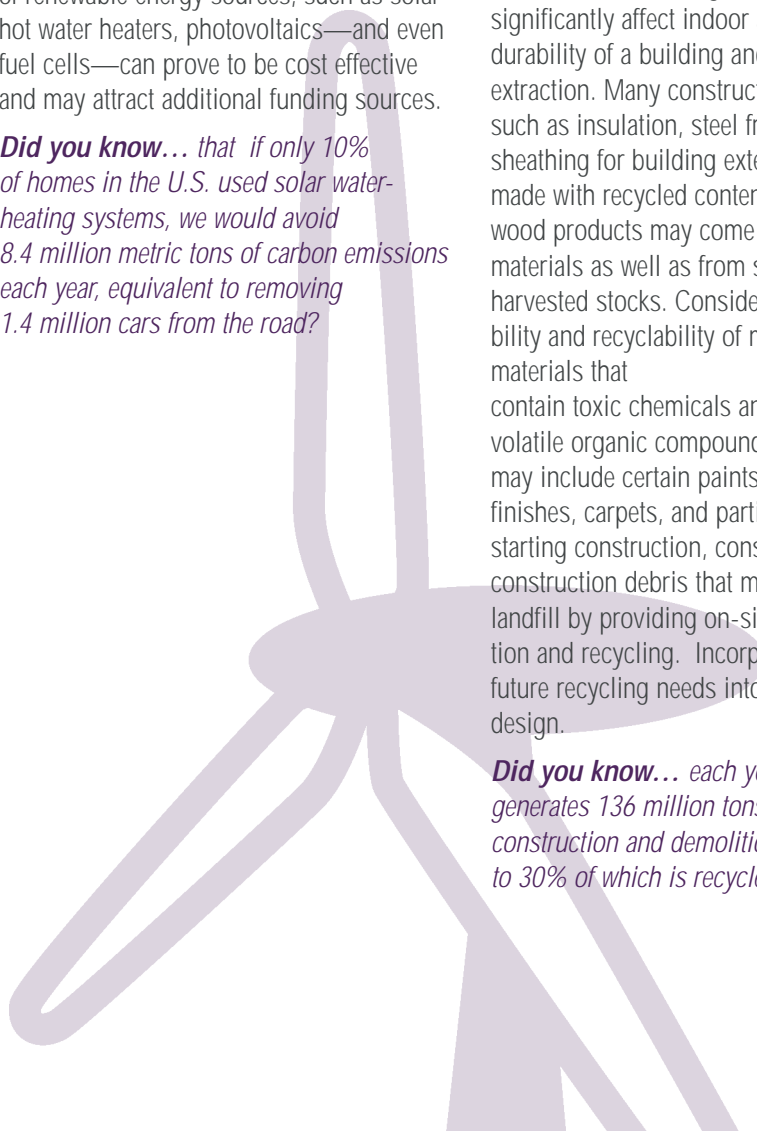
Buildings have a tremendous impact on water consumption and water quality. Natural systems for conserving water and reducing runoff—such as grading, bioswales, bioretention, and reduction of impervious surfaces—should be considered. Install efficient appliances and fixtures and consider re-use of water from sinks, showers or washing machines (known as greywater) for flushing or irrigation, to significantly reduce water consumption and costs.

***Did you know...** that the average U.S. household uses 146,000 gallons of water per year and that some streams and rivers in Massachusetts actually run dry—or run backwards—as result of water withdrawals during the summer?*

Issue #3: Site selection, building orientation and landscaping

Buildings should be sited where they will have the least impact on the natural environment, and where they can be reached by foot, bike, or mass transit, whenever possible. Building orientation should employ natural heating, cooling and shading strategies, using the position of the sun and placement of vegetation for shelter and shade to complement mechanical lighting and heating and cooling systems; reduce the amount of hard, impervious surfaces (such as parking lots) to minimize water run-off; use non-invasive plants and other landscaping techniques, such as minimizing lawn size, to reduce maintenance, decrease pesticide and fertilizer use, and lower water consumption.

***Did you know...** that a temperature difference of 16 degrees can exist between shaded and unshaded sides of a building?*





Sustainable Design – The Process

Introducing the concept of sustainable design early in the process will help maximize benefits without adding to the cost.

Issue #1: Set and Measure Goals and Targets

Explicit performance goals should be set as early as possible in the project with the participation of all major stakeholders including those involved in the design, construction, use and operating aspects. Make sure to set targets for annual energy and water use. Invest time and resources in the initial planning and design, focusing on energy, operations and maintenance costs, building performance, environmental impact, resource and water conservation, and indoor air quality. One approach for setting goals is through a “charrette”, where design ideas are discussed and analyzed in a gathering of all stakeholders and design specialists.

Issue #2: Build Collaborative Teams

Give all those involved in the design, construction, use and maintenance of a building the opportunity to provide input into the design process. These groups should be able to work together to address a variety of needs, and questions. Hire design and construction professionals with expertise in sustainable design and who are responsive to the team's interests.

Issue #3: Integrate Sustainability into Design From the Beginning

Sustainability decisions made at the beginning of the process tend to cost less and be more effective. Design decisions should be made in the context of integrated building design, and not on a system-by-system approach. Reserve a portion of the budget for building commissioning to test, balance, and ensure proper operation and maintenance of systems after building construction.

Issue #4: Analyze the Facts

Life cycle costing is a tool useful for screening strategies to provide heating, cooling, ventilation, and other amenities to a building's occupants. Rather than focus solely on first costs, life cycle costing takes into account additional expenses encountered during the building's use. Operating costs, maintenance costs, and replacement costs are all typically included in such an exercise. Computer modeling tools can provide important and quantifiable information to the design team about efficiency and annual energy costs. Rating systems, such as the U.S. Green Building Council's LEED™ system, can help teams to quantify and evaluate design criteria.

Issue #5: Reflect Goals in Building Specifications and Contracts

Environmental performance standards, protection of indoor air quality during construction, and waste management plans can be included in building specifications to ensure their implementation. These specifications will be most effective if started early in the process and implemented consistently throughout it. An important step is to continue the commissioning process after the building is constructed.

Leading by Example: Mount Wachusett Community College

Converting its electric heating system to one fueled by waste wood chips, Mount Wachusett Community College expects to save 3.3 million kilowatt hours of electricity per year—saving \$300,000 annually in reduced energy costs—or enough power to serve 100,000 residential customers for a year. Wood energy, or biomass, is cheaper than many other fuels and, when compared with oil or coal, reduces emissions of Sulfur Dioxides (which cause acid rain) and greenhouse gases (which cause global warming). The 1000 tons of wood chips used to fuel the system annually are lumber byproducts from local sawmills. Because the wood chips are purchased locally, transportation related impacts are minimized, use of petroleum fuels is eliminated, and energy dollars are spent in the local economy.

Mount Wachusett Community College received partial funding from the U.S. Department of Energy and the Massachusetts Technology Collaboratives Renewable Energy Trust to complete the project. This project is also being funded through a Tax Exempt Lease Purchase at no net cost to the Commonwealth.

Sustainable Design Players

There are several key players in sustainable design issues in Massachusetts. These include:

Division of Capital Asset Management (DCAM)

DCAM is the central design and construction office for all significant new construction and renovation projects at state facilities. DCAM's team of engineers, architects and project managers include dedicated staff who incorporate sustainable design elements into state projects that help meet the needs of agencies. DCAM has established sustainable design guidelines that are used to direct sustainable design within the agency and on behalf of those whose projects it manages. www.state.ma.us/cam/statewide/swsustain05.html

Mass Technology Collaborative's Renewable Energy Trust Fund (MTC)

Through its Green Buildings Program, the MTC has provided grants to public schools and other buildings to incorporate renewable energy technologies into their design and construction. The MTC provides direct project support as well as education and outreach programs, which promote renewables and energy efficiency. www.masstech.org/massrenew/greenbuildings.htm

The Executive Office of Environmental Affairs/State Sustainability Program

EOEA's State Sustainability Program was established by Executive Order #438 in July of 2002 to promote sound environmental practices at state agencies. The Program helps to promote sustainable design efforts, conduct research on innovative approaches and bring together diverse stakeholders. www.mass.gov/envir/sustainable.htm

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The LEED™ Standard

The United States Green Building Council (USGBC) has developed a tool to answer the question: "What is a green building?" LEED™, or "Leadership in Energy and Environmental Design," is a rating system used by building designers and owners to establish universally accepted guidelines and performance targets. These targets focus on energy and resource efficiency, indoor environmental quality and minimizing negative impact on the environment. Since its emergence in the market, LEED™ has been adopted by the Federal Government, the US Army, US Navy, cities, and many other private and public sector building owners. There are currently 420 buildings registered with LEED™.

This nationally recognized standard for green buildings provides a range of green building certification levels, ranging from the standard to the platinum ranking. For more information go to www.usgbc.org

www.epa.gov/greenbuilding - The U.S. Environmental Protection Agency's website promotes green building practices to reduce energy use, water consumption, and waste materials while creating healthier indoor environments.

www.sustainable.doe.gov/buildings/gbintro.shtml - The U.S. Department of Energy's website contains information on green design, construction, and maintenance of buildings.

www.mass.gov/osd/enviro - The Massachusetts Environmentally Preferable Products Procurement Program promotes the use of environmentally preferable products and services.

www.ciwmb.ca.gov/GreenBuilding - California Integrated Waste Management Board's website posts information on sustainable building basics, materials, specifications, programs, and case studies.

www.greenguide.com - The Green Building Resource Guide is a database of over 600 green building materials and products selected for their usefulness to the design and building professions.

www.buildinggreen.com - BuildingGreen.com has articles, reviews, and news stories that are a prime resource on energy-efficient, resource-efficient, and healthy building practices.

www.greendesign.net/gbrc/index.html - The Green Building Resource Center includes more than 600 green building resources.

www.nesea.org - The Northeast Sustainable Energy Association (NESEA) promotes energy conservation and renewable energy technologies.

www.wbdg.org/index.asp - National Institute of Building Sciences' Whole Building Design Guide is for architects, engineers, and project managers to improve the performance and quality of their buildings.

www.greenbuildingadvisor.com - Green Building Advisor is a software program that assists architects and other building professionals in designing design occupant-friendly and environmentally-friendly buildings.

www.greenbuildingmaintenance.com - Green Building Maintenance™ is a philosophy of operating buildings in a safe, responsible and efficient manner.

www.greenroundtable.org - The GreenRoundtable is a Massachusetts based non-profit, which coordinates a dialogue to promote and support healthy and efficient sustainable buildings.